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Production Capacity of Several Hybrid Genotypes of *Jatropha curcas* Linn. for Five Years in Pasuruan, East Java – Indonesia.

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Abstract. *Jatropha curcas* Linn. is one of shrubs mainly exist in tropical area. The research team has succeeded to produce several excellent hybrid genotypes which then were planted to be tested its production capacity for 5 yr. Those genotyes were: genoptype 5 (HS49 × SP34), genotype 6 (HS49 × SM35), genotype 7 (HS49 × IP1A), and genotype 18 (SP16 × SM35). This research aims at finding out the production capacity of several hybrid genotypes of *J. curcas* Linn. which was conducted for 5 yr in Kedung Pengaron, Pasuruan. The research was arranged in Randomized Complete Block Design with four repetitions. Each block contained 20 plants, with plant treatment of hybrid result of genotype 5 (JC5), 6 (JC6), 7 (JC7), 18 (JC18) and two comparators of IP3A and IP3P. Observation was conducted on the number of fruit bunches and fruit on each plant, the number of fruit per plant, seed dry weight per plant. The study showed that *J.curcas* hybrids of genotypes JC5, JC7 and JC18 had higher production capacity (in term of number of fruit per plant, seed dry weight per plant and dry weight of 100 seeds) than other genotypes (JC6, IP3A, IP3P) in environment with drought stress.

Key words: Drought stress, genotype, *Jatropha curcas*, production capacity.

1 Introduction

Jatropha curcas Linn. is a member of shrubs plant which is mainly found in tropical area and is included as an alternative plant for biodiesel [1]. *J. curcas* is including the succulent plan, its leaves close in dry season, so this plant has a very good adaptation in dry and semi-arid

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regions [2]. It is also known as medicinal plant. Nowadays it also has gained more attention on its other function as biofuel source due to its seed's oild content [3].

The research and development agency has launched planting material in the form of IP1 seed with production potential of (3 to 4) t ha^{-1}, (5 to 7) t ha^{-1} [4] and IP3 of (8 to 9) t ha^{-1} [5]. During the past 5 yr, there has been a research on production capacity on several genotypes of *J. curcas* hybrid. Based on result ptential and its seed's oil content selection, there were four genotypes with higher result compared to others in drought stress condition, they were genotype number 5 (HS49 × SP34), 6 (HS49 × SM35), 7 (HS49 × IP1A) and 18 (SP16 × SM35) [6].

The production capacity of four genotypes of *J.curcas* hybrid has been conducted in Experimental Garden of Kedung Pengaron, Pasuruan, East Java, Indonesia for 5 yr. The research aimed at finding the production capacity on the plant under drought stress condition. The environmental factor referred to all factors except genetic ones, which might affect the phenotype of a certain plant characteristics [7]. The environmental factors here include not only growing environment, but also the different of weather, plant duration, harvesting time, fertilizer dosage, length or planting, planting pattern, irrigation level, drought condition and others. Plant production from time to time was varied depending on genetic stability, environment, and the interaction between genetic factors and its environment.

The initial test result showed that the seed's oil content was ranging between 27.04 % to 35.24 %. The highest oil content was gained from hybrid of SM35 × SP38 in Experimental Garden of Kedung Pengaron, Pasuruan, which was of 35.24 %. From four dry lands in the research, the highest oil content was achieved from hybrid of SM35 × SP38 with its content of 32.035 % [6].

2 Objectives

This research aimed at finding the production capacity of several hybrid genotypes of *J. curcas* Linn. within 5 yr period in Experimental Garden of Kedung Pengaron, Pasuruan, East Java, Indonesia. This research is expected to produce a *J. curcas* Linn. genotype with a high production capacity in drought stress environment.

3 Methodology

This research was conducted at Kedung Pengaron, Pasuruan, East Java. The agroecology specification of field is specified in Table 1. The *J. curcas* Linn. experiment was conducted in 5 yr, from the year 2012 to 2016 [8].

Table 1. The rainfall intensity (mm per month) at Pasuruan, East Java [8].

Month	2012	2013	2014	2015	2016
January	219	26	233	10	8
February	92	23	68	5	13
March	24	17	183	3	3
April	50	25	12	4	2
May	32	20	1	2	2
June	-	34	8	-	7
July	-	6	3	-	-
August	-	-	-	2	-
September	-	-	-	-	-
October	-	-	-	-	29
November	55	34	-	2	2
December	79	8	169	9	9

Instruments and tools applied in this research were: oven, agricultural tools, stationaries, hand sprayer, plastic, research identity board, camera, logbook, pylox, sack, mower, etc. Material used in this research were: various genotypes of *J. curcas* seeds, herbicide, urea, phonska and pesticide. The research was arranged in Randomized Complete Block Design with four repetitions. Each block's size is 10 m × 8 m with plant space of 2 m × 2 m so that each block consisted of 5 × 4 plants. Treatment being tested were hybrid genotypes of JC5, JC6, JC7, JC18 and two comparators of IP3A and IP3P [9]. Planting had plant space of 2 m × 2 m which was divided into four groups and each group consisted of 20 plant samples so that there were 480 plants material in total. There was no watering process during the observation for the research itself is aimed at producing a *J.curcas* Linn. genotype with a high production capacity in drought stress environment. The plant's water requirement merely achieved during rainy season.

Observation was conducted toward the number of plants' fruit bunches per plant,fruit per plant, seed's dry weight per plant and seed's dry weight per 100 seeds. Fruit harvesting was conducted after the seed was ripe. The characteristics of ripe seed can be viewed from its yellowish brown rind. When the rind has begun to open it means that the seed has ripen. Too early harvesting time would decrease the oil content, while the late harvesting caused ruptured fruit resulting in more lost seed. Data analysis result by F test gained 5 % and 1 %, it was proceeded by Tukey test on level 5 % by using Software Statistical Analysis System (SAS) version 9.0 Portable.

4 Results and analysis

The analysis result showed that the genotype had a significant influence toward the fruit bunch per plant. Genotype that has high production capacity does not always perform similarly in different location (specific location). Fact is in line with a statement from [10] that the level of production capacity of certain plant is greatly depended on the environment where the genotype is planted and the type of genotype itself. The genotype interaction with its environment is a result of response from each genotype being tested on each growing environment of [11]. Based on that statement, it is definite that choosing the genotype with the best fruit bunch, breeders must choose one typical genotype for each different environment.

Table 2. Average fruit bunches per plant for each genotype of *J.curcas* at Kedung Pengaron, Pasuruan, Indonesia for 5 yr.

No.	Genotype*	Pasuruan*				
		Year				
		2012	2013	2014	2015	2016
1.	JC5	12.74 ab	37.59 a	13.86 a	41.29 b	22.43 a
2.	JC6	10.93 abc	40.09 a	12.57 ab	75.24 a	14.46 bc
3.	JC7	13.90 ab	36.17 a	15.06 a	39.79 b	17.83 abc
4.	JC18	19.72 a	38.21 a	15.14 a	52.95 ab	19.98 ab
5.	IP3A	7.56 bc	20.04 ab	11.54 ab	40.00 b	17.43 abc
6.	IP3P	5.66 c	29.07 b	9.22 b	40.40 b	14.01 c

Note: (*)The number which is followed by similar alphabet in the same column is not significantly different based on Tukey test on level of 5 %.

The average of fruit bunch per plant of each genotype for 5 yr (2012 to 2016) is presented in Table 2. From six genotypes being tested, JC5, JC7 and JC18 produced consistently higher fruit bunches compared to their comparators, the genotypes IP3A and IP3P. The JC6 genotype was potentially able to produce 75.24 bunches of fruit/plant in the 4th year. Plant with high level of adaptation skill has a more stable production capacity [12]. This shows that

the particular plant owns adaptation skill toward different environment [13]. A genotype with the same adaptation and productivity capacity on different environment proves a static stability, while the adaptation skill which follows environment index shows a dynamic stability [14].

An evaluation of several *J.curcas* germplasm collection at Experimental Garden of Pakuwon, East Java and at Experimental Garden of Asembagus, East Java has shown a variety of morphological characteristics and production capacity [15]. Apart from genetic factor, the different growing environment and plant age may affect the influorescent in fruit bunch production. production capacity of plant greatly depends on its genotype's growing environment and the genotype itself [10].

Table 3. Average fruit bunches/plant on each genotype of *J.curcas* in Pasuruan,Indonesia for 5 yr.

No.	Genotype*	Pasuruan*				
		Year				
		2012	2013	2014	2015	2016
1.	JC5	28.38 a	107.58 a	61.89 a	156.68 ab	114.19 a
2.	JC6	26.42 ab	116.44 a	54.53 a	75.90 c	64.96 c
3.	JC7	49.70 a	111.94 a	60.66 a	141.08 b	86.74 bc
4.	JC18	44.28 a	107.21 a	53.65 a	187.84 a	101.08 ab
5.	IP3A	18.73 ab	53.63 b	24.02 b	144.50 b	81.28 bc
6.	IP3P	11.48 b	108.00 a	26.53 b	132.58 b	63.96 c

Note: (*)The number which is followed by similar alphabet in the same column is not significantly different based on Tukey test on level of 5 %.

The average of fruit per plant of each genotype for 5 yr (2012 to 2016) is presented in Table 3. Genotype JC18 was potentially able to produce 187.84 fruit/plant in the 4th year. The rainfall intensity was the most important weather factor in growing J.curcas. Limited water affecting jatropha production [16].

Table 4. Average seed's dry weight/ plant on each genotype of *J.curcas* in Pasuruan for 5 yr.

No.	Genotype*	Pasuruan*				
		Year				
		2012	2013	2014	2015	2016
1.	JC5	46.47 a	213.94 a	133.73 a	275.00 ab	222.58 a
2.	JC6	41.50 ab	230.44 a	99.72 b	214.30 c	125.98 c
3.	JC7	41.07 ab	233.44 a	110.17 ab	221.90 ab	163.27 bc
4.	JC18	52.80 a	230.06 a	115.02 ab	629.20 a	192.25 ab
5.	IP3A	24.88 ab	106.90 b	57.69 c	217.70 ab	140.29 bc
6.	IP3P	16.20 b	214.10 a	64.38 c	202.30 b	113.25 c

Note: (*)The number which is followed by similar alphabet in the same column is not significantly different based on Tukey test on level of 5 %.

The average of seed's dry weight/plant of each *J.curcas* genotype in Pasuruan for 5 yr (2012 to 2016) is presented in Table 4. Based on observation result, in a year the plant produces twice, it is in rainy and dry seasons. Seed production during rainy season is higher than in dry season. The above data shows total production in a year, both from rainy and dry season.

Genotype had significantly affected the seed's dry weight of 100 seeds. JC5 genotype produced 100 seeds of 74.38 g on 5th year (Table 5), which is not much different with JC7 and JC8. The three genotypes produced the average of dry weight of 100 seeds higher than IP3A and IP3P. In general, the obtained data showed that the production capacity of *J. curcas* for 5 yr was not very significantly high. Yet, this plant cultivation system, as stated in

research method, was conducted without any watering process (only depended on water during rainy season). This has become the advantage of tested genotype, for those genotypes have proven its potential, which is tolerant toward drought stress when compared with IP2A and IP3P. The JC5, JC7 and JC18 genotypes showed higher production capacity potential compared to the other three genotypes.

Table 5. Average seed dry weight per 100 (g) on each *J.curcas* in Pasuruan for 5 yr.

No.	Genotype*	Pasuruan*				
		Year				
		2012	2013	2014	2015	2016
1.	JC5	69.94 a	69.69 a	69.79 a	70.57 ab	74.38 a
2.	JC6	66.46 ab	70.42 a	64.17 a	69.94 ab	66.88 bc
3.	JC7	68.97 a	68.33 a	69.17 a	71.23 a	70.00 ab
4.	JC18	72.61 a	68.13 a	68.75 a	70.85 ab	70.00 ab
5.	IP3A	60.05 b	63.13 b	69.79 a	68.36 ab	61.88 c
6.	IP3P	68.22 a	63.13 b	67.50 a	67.59 b	61.25 c

Note: (*)The number which is followed by similar alphabet in the same column is not significantly different based on Tukey test on level of 5 %.

5 Conclusion and recommendation

The result of the study showed that *J. curcas* Linn. hybrids of genotypes JC5, JC7 and JC18 had higher production capacity (in term of number of fruit per plant, seed dry weight per plant and dry weight of 100 seed) than other genotypes (JC6, IP3A and IP3P) in experimental garden of Kedung Pengaron, Pasuruan in environment with drought stress.

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